

REPORT ON POSSIBILITIES OF ESTABLISHMENT
AND MAINTENANCE OF SALMON AND STEELHEAD
RUNS IN CACHE AND PUTAH CREEKS¹

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Introduction

The present report and recommendations contained therein are based largely on the data gathered by the writer during surveys made of the entire Cache and Putah Creek systems at various times during the spring and summer of 1940. A preliminary survey was made in March and the most intensive work was done during the period June 17 - 28. The work was conducted under the auspices of the Bureau of Fish Conservation of the California State Division of Fish and Game, at the request of the North Coast Council of the California State Chamber of Commerce, the Clear Lake Wildlife Council, and other interested parties who wished to have information regarding the possibilities of establishing or re-establishing and maintaining runs of salmon and steelhead in Cache and Putah Creeks.

Grateful acknowledgement is made to the several persons who accompanied the writer on his various trips or who furnished him with much valuable information. Among these are Ranger Hugo Lindbloom of the State Division of Forestry,

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Captain J.D. Dondero, Merrill Brown, and Abe Woodard of the Division of Fish and Game, and a number of local residents.

The writer previously had submitted a preliminary report entitled "Report on proposed rehabilitation of salmon and steelhead runs in Cache and Putah creeks" to the Division of Fish and Game on March 11, 1940.

It might also be noted that U.S. Bureau of Fisheries workers who had made a study of the Shasta Dam salmon salvage problem in their report dismissed Cache and Putah creeks from consideration in any salvage plans for salmon now going up the Sacramento River past Redding on the basis of their distance from that point (136 miles for Cache Creek and 145 miles for Putah Creek) and their lack of suitable water (Hanson, Smith, and Needham, 1940).

General Description of the Watersheds

Cache and Putah creeks nominally are tributaries of the Sacramento River on its west side, but in recent years no water from these streams has reached the Sacramento River through their original channels because of the complex system of water use and flood control in their lower reaches, which will be discussed later in this report. In physical characteristics, Cache and Putah creeks are much alike. In order to present a better understanding of the topography and location of these

streams, the following general description is quoted from McGlashan (1929).

CACHE CREEK

"The Cache Creek drainage basin lies on the eastern slope of the Coast Range in Lake, Colusa, and Yolo counties, immediately south and west of the south end of the Stony Creek Basin and north of the Putah Creek Basin. The upper part of the area, comprising about 824 square miles, lies in the central part of Lake County, south of the divide separating the Eel River and Cache Creek Basins. It is roughly rectangular in shape, and contains Clear Lake in its center. From Lake County the basin extends southeastward to the Sacramento Valley as a strip about 50 miles long and 10 miles wide. The total area of the basin is 1,290 square miles.

"Cache Creek is the only known outlet of Clear Lake. The lake is very irregular in shape and has an area of 65 square miles and an altitude of 1,325 feet at mean level. Its length is 20 miles and its greatest width 7 miles. The upper part, or main lake, has a maximum depth of 35 feet, but the lower neck has a few small areas as much as 50 feet in depth. The drainage area tributary to the lake is about 417 square miles, chiefly toward the south and west. The principal creeks flowing into the lake are Scotts, Middle, and Clover from the west, and Doba, Kelsey, and Cole⁸ from the south. They are torrential during the rainy

⁸ Cole Creek is not named on Punnett's map of Lake County or on the sketch map accompanying Water-Supply Paper 45 (Pl.I).

season, but are practically dry in the summer.

"From the lake Cache Creek flows southeastward to the Yolo Basin and ultimately into Sacramento River through sloughs. Its total length is about 80 miles.

"The largest and most important tributary of Cache Creek is the North Fork, which drains 250 square miles in the eastern part of Lake County. The only other important tributary is Bear Creek, which drains the western part of Colusa County. These creeks are very small in the summer, but rarely become dry. All the tributaries are torrential during the rainy season.

"The upper part of the Cache Creek drainage basin in Lake County is mountainous and very rugged. Some of the peaks reach an altitude of 6,000 feet above sea level, and their slopes, as well as those of the lower ranges, are very steep. About 5 miles below the outlet the creek enters Cache Creek Canyon, in which it flows for 25 miles on an average grade of 35 feet to the mile. In some places the canyon walls are vertical cliffs 300 feet high. Below the canyon the creek enters Capay Valley, from 1 to 3 miles wide and 20 miles long, through which it winds for a distance of nearly 30 miles before entering the Sacramento Valley.

"On the northern slope of the ranges around Clear Lake are fine belts of fir, oak, and pine. Elsewhere on the high ranges the vegetation consists of a dense growth of greasewood and chaparral. A strip along the northern edge of the basin is included in a national forest.

"The mean annual precipitation ranges from 17 inches in the Sacramento Valley to 40 inches or more on the mountainous summits in Lake County, where much of it occurs as snowfall in the winter.

"The upper part of this basin contains springs, a number of which, especially in the North Fork Basin, have medicinal properties that attract many visitors."

PUTAH CREEK

"The Putah Creek Basin lies on the eastern slope of the Coast Range south of the Cache Creek Basin and north of Napa Valley. It includes the southern part of Lake County, the northern half of Napa County, and small parts of Yolo and Solano Counties. The basin is rather long from northwest to southeast and comparatively narrow, being about 20 miles wide at the north and less than 10 miles at the east. It has a total area of about 810 square miles.

"Putah Creek rises in the northwestern corner of the basin in the St. Helena Range and flows southeastward into the Yolo Basin near Davis, and thence into Sacramento River through Cache Slough. The total length of the creek is about 80 miles. It has numerous tributaries which have a heavy flood discharge in the winter but are practically dry during the summer. The chief tributaries are Soda Creek from the north and Pope Creek from the west.

"The topography of the Putah Creek Basin is very rugged. Much of the upper basin is rough and precipitous. The underlying rock is an impervious slate and serpentine with only a thin soil covering. There is very little tilled land in the basin except below the foothills. Altitudes range from about 100 feet in the valley to about 5000 feet on the mountain summits.

"The lower parts of the basin are comparatively barren of timber, though they support a considerable growth of grass and brush which extends down as far as the foothills. At moderate altitudes timber grows scatteringly, and the mountain summits are covered by a fairly heavy timber growth.

"The mean annual precipitation varies widely in the different parts of the basin. Along the foothills it averages about 28 inches, in the central part about 40 inches, and along the crest of the divide, where some of it occurs as snowfall in the winter, about 65 inches. Helen Mine, on the northern slope of Mount St. Helena, receives almost 100 inches annually.

"Below the foothills is a large area of rich irrigable land, which could be supplied with water from Putah Creek. Some of this land is already irrigated and has been proved to be susceptible of the highest state of cultivation.

"At least two good reservoir sites exist on the main stream, one near Winters and the other near Guenoc."

To the foregoing description it may be added that in the upper reaches of both the Cache and Putah creek systems, small, permanent tributaries enter the main streams through narrow, wooded and brushy canyons. In a number of these trout may be found and the temperatures normally are below 70°F. Some of these small tributaries start in springs. But as these streams reach or approach the main streams they usually dry up in the summer months (Figs. 1 and 2) and the trout are replaced by the assemblage of fishes typical of the lowland areas of the Sacramento River system; Carp, various native minnows (Cyprinidae), suckers, black bass, and sunfishes. Summer water temperatures that often exceed 80°F. prevail. The surrounding terrain becomes less rugged and the sparsely wooded foothills are replaced by the fields and orchards of the Sacramento Valley. Those sections of both Cache and Putah creeks that flow through the Valley become intermittent during the summer months, even in years of abundant rainfall (Fig. 3). In part this is a natural condition, in part it is caused by the use of water for agricultural purposes, either by direct diversion or by pumping, and in part by flood control measures, road construction, grazing, and other man-created activities that have caused erosion and consequent silting up of the stream beds. These factors will be discussed in greater detail later in this report. It will suffice to say at this time that whatever are the factors, the fact remains that these streams are dry in portions and that the water in the intervening stretches is of high enough temperature to render them unsuitable for trout and salmon

except in the winter and spring months.

Flood Control and Water Use.

A description of the principal changes that have taken place in the lower courses of Cache and Putah creeks as a result of man-made projects will now be described.

As previously stated, no water from either of the streams reaches the Sacramento River by way of the original channels, even at high water, but flows into the Yolo By-Pass and thence down the By-Pass to the latter's entrance into the sloughs entering the Sacramento River between Rio Vista and Walnut Grove. The Yolo By-Pass is a large, artificial, cut and diked channel that extends from Verona (a little below Knights Landing) to the above-mentioned point. It was constructed to care for the excess water of the main Sacramento River at flood stage. Throughout most of each year the Yolo By-Pass is dry and is planted to beans and other crops or used as grazing land. When the Sacramento River is at flood stage and reaches a certain level it spills over the Fremont Weir, located at the head of the Yolo By-Pass, and flows down the By-Pass. In years of little rainfall no water runs down it, even in the winter months. On the east side of the Yolo By-Pass there is a main cut and this cut carries water through most of the year, even when other portions of the By-Pass are dry. The tide extends up this main cut to a little above

the point of entry of the sewage from Woodland, i.e., above the present entrance of Cache and Putah creeks.

The old main channel of Putah Creek ran through the grounds of the University of California College of Agriculture at Davis. Now there is only a small, local flow in this channel, which is also known as the North Fork of Putah Creek, and the dairy refuse from the College of Agriculture empties into it. This old channel is cut off from the main flow of Putah Creek, which goes down what is known as the South Fork of Putah Creek.

Near the old bridge crossing near the Mt. Diablo Gun Club, on the Cowle Property in the Yolo By-Pass, Putah Creek breaks into several channels or sloughs (Fig. 4). When there is sufficient flow the water of Putah Creek flows into the Long Ponds, which are lakes in the Yolo By-Pass. On June 21, 1940 the water was reported still to be flowing into Long Ponds, but the ground was yet too wet around them to reach them with an automobile. Bean fields in this region were just being planted on this date. During the summer of 1939 the narrow, long pond of Long Ponds went dry.

During the winter of 1939-40 the water was 5 feet deep at the Mt. Diablo Gun Club. At that time the overflow of Putah Creek united with the water coming down the Yolo By-Pass and flowed in a big channel during the winter and early spring, flowing into the main cut of the Yolo By-Pass between the Sacramento Northern R.R. and Long Ponds.

There are several lakes or ponds in the Yolo By-Pass in the vicinity of Sacramento. Gradually these are drying up and becoming smaller. Abe Woodard reports that in former years there were sturgeon, Striped Bass, salmon, and other fishes in Long Ponds, Todhunter Lake, Green Lake, and the other lakes of this region.

Several years ago a break-through occurred in the west levee of the Yolo By-Pass, (Fig. 5), and it is through this break that the Woodland sewage and Cache Creek now enter the By-Pass. The sewage runs in a pipe to this break, then in a pipe through a solid concrete dam crossing Cache Creek cut or slough, then through an open ditch across the Yolo By-Pass (Fig. 6) to the east side of the By-Pass, where it empties into the cut or channel extending down the length of the By-Pass on the east side.

The old channel of Cache Creek now comes to a dead end against the north levee of the Yolo By-Pass. A photograph of this dead end of the channel is shown in Fig. 7.

Dams on Cache Creek

There are three dams on Cache Creek, all owned, insofar as I know, by the Clear Lake Water Company of Woodland. The uppermost dam is known as the Clear Lake Impoundment Dam, the middle dam as the Capay Dam, and the lowermost one as the Moore Dam. None of them has a fishway, but the Moore Dam is removed in winter and is then not an obstacle to fish. The others are impassable to fish.

1. Clear Lake Impoundment Dam. As its name implies, this dam was built for the purpose of increasing the storage capacity of Clear Lake over the normal amount and to regulate the flow out of the Lake. No water is diverted at this point.

This dam is located in T. 12 N., R. 6 W., Section 6, at an elevation of 1250 ft. (Fig. 9). It was constructed in 1914 at a cost of \$117,777. It is of the gravity-straight type. The distance from crest to stream bed is 33 ft., and to foundation 36 ft. The length of the crest is 260 ft. There is no spillway. The storage capacity is 420,000 acre feet and the drainage area 420 sq. mi.

At high water some fish can get past the dam with some difficulty, since at such times the outlet gates, which are located at the bottom of the dam, are opened. One of

the local residents of Clear Lake told me that in 1937-38 some steelhead ascended Cache Creek past all three dams and were taken in Clear Lake. The caretaker at the dam reported that he has seen large Sacramento Squawfish, known locally as "Chapaul", Ptychocheilus grandis (Ayres), pass upstream through these gates, but that he has never seen adult salmon or steelhead at the dam. It is possible that the fish reported from Clear Lake were large resident trout or large trout that had come down into the lake from some of its tributaries.

2. Capay Dam. This dam (Fig. 9) is located near the small town of Capay, Yolo County. It was built about 1912. It is 10 ft. high and 600 ft. wide at the top. In the spring a 3 foot extension of flash boards inserted in H-beams is placed across the entire dam; this extension was in place when the dam was seen on June 18. The only water going past the dam at the time was seepage. A wooden apron is present. There are two outlet gates near the bottom of the dam but these are never used.

A large diversion takes off from each side of the dam. The south diversion, known as the Capay Canal, is shown in Fig. 10. On June 18 the flow in the south diversion was 303 second feet and that in the north diversion, known as the Adams Canal, 144 second feet. At 1:35 p.m. the water temperature in the south diversion at the head was 80°F. The air temperature was 90.5°F. and the water partly cloudy. As screening on the south

diversion there is only an iron grid with bars spaced 3 inches apart.

Capay "Reservoir" is now silted in to the top of the dam, so that there is practically no storage of water.

It is of interest to note that in 1912 Warden R.L. Sinkey reported to the Division of Fish and Game: "I understand provisions have been made for a fish ladder and screens."

3. Moore Dam. This dam is located on Cache Creek about 12 miles below Capay Dam (Figs. 11 and 12). It is about 4 ft. high. One branch of the diversion from the north side of Capay Dam (Adams Canal) is brought down to the Moore Dam, where it crosses over to the south side of the stream immediately above the dam. In other words, the diversion from the north side of Capay Dam empties into the reservoir formed by Moore Dam and is taken out again from the south side of Moore Dam, whereupon it is known as the Moore Canal. The Moore Dam, which was seen on June 18, had been put in about eight days previously. When seen considerable water was going below the dam; the water running over the dam was about 50 yards wide and one inch deep.

At 2:20 p.m. the water in the head of the diversion was 76.5°F. The air temperature was 87°F. and the weather partly cloudy. Evidently the water cools down as it runs in the north diversion from Capay Dam, being more protected in the shaded diversion than it is in the exposed to semi-exposed stream bed.

In 1912 Warden R.L. Sinkey reported of Moore Dam:
".....during high water has fish ladder,....." and that "Screens
were put at this dam this last spring."

Dams on Putah Creek

The only dams on Putah Creek are the one known as the Putah Creek Dam at Winters, Yolo County, and a temporary one on the Bar X Ranch between Middletown and the "Steel Bridge". Neither of these dams has a fishway, but each is removed in the winter and is then no obstacle to fish.

1. Putah Creek Dam. This dam is located in T. 8 N., R. 1 W., Section 22, at an elevation of 107 feet (Fig. 13). It is owned by the City of Winters. This dam is of the gravity type; flashboards are used. The distance from crest to streambed is 11 feet, to foundation 18 feet. The crest length is 170 feet. It has a concrete base and concrete buttresses at the sides. There are three outlet gates in the center of the dam. The cost of construction was \$15,168. The storage capacity is 177 acre-feet and the drainage area 655 square miles.

There are no diversions leading from this dam and the reservoir serves essentially for percolation. Water is also pumped for irrigation from the impounded water behind the dam.

In 1912 Warden R.L. Sinkey reported: "At Winters a temporary dam is put in Putah, which gives them an artificial

lake. An opening is left at the base of the dam to allow what fish there are to pass through."

2. Dam on Bar X Ranch. This dam is located on the Bar X Ranch, between Middletown and the "Steel Bridge" in Lake County. Water is diverted for irrigation. State Forest Ranger Hugo Lindbloom reports that this dam is not a barrier to fish in the winter.

Water Flows.

Cache Creek

In 1939 Cache Creek went completely dry below the Capay Dam and was dry except for isolated pools above the dam as far as Rumsey. During most years in the summer the size of the flow in Cache Creek is almost entirely dependent upon the amount of water let out of Clear Lake. In the summer practically all of the water is diverted at Capay Dam, so that the stream is nearly always dry below that point.

In 1912 Warden R.L. Sinkey reported that Cache Creek was usually "practically dry" at the Moore Dam from July until the onset of the winter rains. He also wrote as follows:

"Main Cache Creek is quite a creek from the Lake out. I would judge on the riffles it would run a stream 2 feet deep, 15 or 20 ft. wide of an average season. The last two years it hasn't been half that size.

"North Cache Creek runs just a small stream. Just enough to keep fairly well cleaned. All the tributaries to North

Cache Creek are just small streams, such as any small mountain stream."

Putah Creek.

In the summer Putah Creek normally goes dry below the Putah Creek Dam at Winters and reappears as a stretch of running water several miles below the dam. This stretch is below Stevens Bridge, on the Phillips ranch. The stream also goes dry above the dam for about three miles (to Cody's). It dries up from about 2 miles above John Storlan's Bridge to about a mile above North Camp (Boy Scout camp). It dries up at the Pope Valley road crossing. The flow in sections in between is permanent, even in dry years.

Underground gravel strata are supposed to take considerable water from the stream.

There are a number of pumps in the vicinity of Winters. Some of them do not pump directly from the stream, but in effect use stream water.

In 1912 Warden R.L. Sinkey wrote of Putah Creek: "Becomes dry anywhere below Winters during summer months." Also: "Putah Creek is just a small stream in the summer time. St. Helena Creek, Anderson Creek, Dry Creek run just small streams. Big Canyon runs more water, I think, than all the rest."

Distribution of Fishes in Cache and Putah Creeks

As might be expected from an examination of the previous description of the drainage basins of Cache and Putah creeks, practically the entire courses of the main streams and the lower courses of most their tributaries are unsuitable for the maintenance of year-round populations of trout, due to high summer temperatures or the lack of water (Fig. 14). In the headwater tributary streams, however, some trout are to be found (Fig. 15). To a large extent these form independent, self-sustaining populations in the different streams.

It is difficult to define the exact limits of the trout populations, and in fact these limits probably vary with the time of year. As in many other California streams that start in wooded, mountainous areas and flow into low valleys, trout are not infrequently caught at the start of the fishing season in the spring in the stretches of stream that flow into the valley floor and which later go dry or attain unsuitable temperatures.

In Cache Creek, trout are reported not to be caught in the vicinity of Capay Dam. Local residents report that the upper portions of the North Fork of Cache Creek and its tributaries are fine trout fishing streams.

During the wet winter of 1937-38 considerable numbers of King Salmon reached Capay Dam and the caretaker at the Clear Lake Impoundment Dam stated that some of them got past it at the time.

In the Putah Creek system, early in the season some trout are caught in the vicinity of Middletown. They are reported to be caught in Coyote Valley. Trout 2 to 3 inches long were present about 150 yards above the mouth of a small, unnamed tributary of Soda Creek, in turn a tributary of Putah Creek, on June 25. This stream is on the Rutherford-Monticello road, in T. 8 N., R. 4 W. In past years some trout have been taken in Putah Creek in the vicinity of Monticello by State fish rescue crews. It is not certain whether these were offspring of sea-run steelhead or stream trout. Some King Salmon have also been taken in the vicinity of Monticello by fish rescue crews.

Unlike trout and salmon, the various members of the sunfish family, such as the black basses, Green Sunfish, and the Bluegill, and the various introduced and native "scrap fish" (non-game fishes), such as the Carp and the various native minnows, are able to withstand high water temperatures and, in most cases, poorer oxygen conditions. As a result of this, the Small-mouthed Black Bass is widely distributed in Putah Creek and spawns extensively throughout almost its entire course.

No young Small-mouthed Black Bass were found in the Cache Creek system and no adults were found, although some of the latter are probably present. It might be pointed out that whereas the water of Putah Creek is quite clear in the

spring and summer, the water of Cache Creek is quite murky. The murkiness of the latter stream is due to the fact that the water is let out of Clear Lake and probably also to the fact that at the Clear Lake Impoundment Dam it is let out through the outlet gates at the bottom, stirring up the bottom materials (Fig. 16). The lack of natural propagation of the Small-mouthed Black Bass in this stream is probably associated with this factor.

Shad are reported to run up Putah Creek, and also to come up Cache Creek as far as the Capay Dam. Striped Bass may also run up to Capay Dam; a few are reported to have been caught below it.

Man-caused Changes in the Character of Cache and Putah Creeks

Extensive water use, flood control measures, and erosion and consequent silting up of the streams and filling in of the holes caused by overgrazing, deforestation, and road construction have increased the temperatures and lowered the summer flows of many of the streams.

There may be some difference of opinion regarding the causes of lower summer flows in the streams of the Cache and Putah creek systems (and in other California streams), but the writer is convinced that such a condition actually exists.

Many persons of long residence on the streams are able to cite changed water levels by comparison with landmarks. A few examples might be cited at this time.

Hugo Lindbloom, Ranger, State Division of Forestry, at Middletown, has lived in the vicinity, especially on St. Helena Creek, for forty-six years. He says that in former years the streams, including St. Helena Creek, did not get as low or dry up as they do now. As causes of changed conditions he cites the straightening of channels, removal of willows, and deposition of tailings from mines, causing the holes to fill up. The Mirabel Mine on St. Helena Creek is one from which tailings have come down the stream over a period of years.

At this point it might be interesting to quote from stream survey notes gathered by the Division of Fish and Game in 1912: "The last few years the goatmen have burned off all the watersheds and have nearly ruined all of the trout streams in Lake County. Nearly all these creeks were nice little summer creeks before the burning was done."

Mr. Lindbloom reports that there was once fine trout fishing in Putah Creek and that his father caught about 15 large trout in it while sitting at one hole. Numerous such examples might be cited. In some cases present absence of trout is due to over-fishing, but in many other cases it is due to the fact that water is no longer suitable for trout. Unfavorable conditions are caused not only by lowered stream flows but also by higher

water temperatures. Temperatures have increased because of lesser volume of water, because the streams are shallower, and because they are more exposed. Lumbering and deforestation caused by burning, road building, and removal of trees in the interests of "flood control" have all contributed to this condition, and have also been responsible for heavier winter run-off, which in turn has caused further erosion and furtherance of the processes cited above. Also, gravel is now taken out of the streams in many places; in such places the water flows over bare rocks and heats rapidly. Floods during the rainy seasons of 1927-38 and 1939-40, caused by excessive rainfall but more devastating in their effect because of the conditions previously cited, have left a noticeable effect on the streams. Big Canyon Creek, which enters Putah Creek not far from Middletown, may be cited as an example of a stream in which the effects of the floods are quite noticeable. Two-tenths of a mile above its mouth a water temperature of 89°F. was obtained on June 26, despite the fact that the flow was about 6 second feet! Two anglers that were met finished the day with empty creels, whereas at approximately the same time in the previous year they had made good catches of trout.

Principally because of increased summer temperatures, the trout have been pushed higher and higher up many of the streams, and as they have been pushed back the various scrap fish, especially the minnows, have proceeded farther and farther upstream, into what was formerly the realm of the trout alone.

Problems Involved and Their Treatment

It was the belief of some of the parties interested in having the survey made that the principal reasons that regular runs of salmon and steelhead are absent from the Cache and Putah creeks is that (1) barriers block their passage and (2) the water in the lower courses of the streams is not used to the best advantage insofar as the fish are concerned, but is dissipated so that no flow through a single concentrated channel reaches the Sacramento River. It was their further belief that if dikes 5 or 6 feet high were built at the lower ends of the streams the water would have direct passage into the Sacramento River and the fish, in turn, free access to the streams, and that if rock slides that they believed to be present were removed and fishways built over the dams, the fish would have an unobstructed passage up the streams to their spawning grounds.

The survey revealed that this conception was only partly true. Because of the high dikes or levees that border and create the Yolo By-Pass there is no readily feasible way of bringing the water from Cache and Putah creeks across the By-Pass to the Sacramento River.

If cuts were made across the By-Pass to carry the water of Cache and Putah creeks to the Sacramento River, the water coming down the By-Pass at flood stage would also enter the Sacramento River through these cuts and defeat the purpose of the By-Pass. The only thing that might be done would be the construction of very large culverts to carry the

waters of Cache and Putah creeks across the By-Pass to the Sacramento River. Such a project and its ramifications would cost not thousands but hundreds of thousands of dollars and would necessitate changes so wide in their scope, affecting agricultural and other interests, that even its consideration seems to fall outside the province of the Division of Fish and Game.

It might be further pointed out that even if such a project were carried out it would simply make Cache and Putah creeks available to spawning runs only when there was water in their lower courses. A study of stream flows shows that at the time that the main salmon run is ascending the Sacramento River there is now normally no flow in the lower portions of Cache and Putah creeks.

A count of the Sacramento River King Salmon made by the U.S. Bureau of Reclamation at the Anderson Cottonwood Irrigation Company Dam at Redding from April 17 to December 6, inclusive, 1939, indicates that the bulk of the fish pass this point in the river from about April 20 to July 10 and from September 10 to December 10. Of course the times of the spring and fall runs will vary somewhat with water conditions of the particular season and it must be further noted that no counts were made at the dam during 1939 prior to April 17 and after December 6. In 1939 the peak of the run at Redding was reached in the latter part of October and was practically over by December 1. The bulk of the fall run probably passes points in the Sacramento River opposite Cache and Putah creeks

earlier than at Redding, so that it appears that if any considerable number of fish were to be attracted into these streams, water in sufficient amounts would have to be available during the months of September, October and November. If it were not available by October 1, there is good indication that the bulk of the potential run into these streams would be lost and if it were not available by November 1, very few salmon could be expected to enter. If the water were not available until December 1, it may be said that the entire run for that year would be lost.

It appears that under present conditions it would be impossible to put into effect any plan that would assure a flow of water in the lower portions of Cache and Putah in all years in the autumn months, when the main run of King Salmon is taking place. In the case of Putah Creek there are no diversion canals, but a number of individually-owned, scattered pumps. It would likely be impossible to secure an agreement from all of the owners to stop pumping at any set date, irrespective of their varying irrigation needs. Furthermore, in 1939, a dry year, there was no flow in portions of Putah Creek even above the majority of the pumps.

In the case of Cache Creek, practically all of the water is diverted into canals at the Capay Dam and the flow above in turn is dependent upon the water let out of Clear Lake. Even if an agreement could be reached to let

sufficient water go past the Capay and Moore dams at all times to attract salmon up the Yolo By-Pass and into Cache Creek, which is highly improbable, it is extremely doubtful that the property owners around Clear Lake would permit the level of the lake to be continued to be lowered for this purpose in the autumn of a dry year, when the lake level was already low.

At present the spring run of King Salmon in the Sacramento River is considerably smaller than the fall run and usually extends from the latter part of April until the middle of July. The fish in the spring run do not mature and spawn until the following autumn, so that cool water is necessary during the summer months. That is probably one reason why certain streams that contain a sizeable fall run do not have a spring run at all. An example of such a stream is the South Fork of Eel River. It is doubtful that any portions of Cache or Putah creeks accessible to salmon possess sufficiently cool water to carry the spring run of these fish until the following autumn, so that it would be useless to attempt to bring the spring run into these streams, even if sufficient water were present in them at the time.

One advantage that King Salmon have over Steelhead Trout in streams in which summer conditions are unsuitable is

that the bulk of young King Salmon normally migrate to sea during the same spring in which they are hatched, whereas most steelhead migrate to sea after they have spent one, two or three years in fresh water. Therefore, if sufficient water is present during the spring in a stream which goes dry during the summer months, the King Salmon have a good chance of maintaining themselves in that stream. However, it must be kept in mind that sufficient water must also be present early enough in the autumn for the adult fish to enter the stream and spawn, which is not the case with Cache and Putah creeks.

On the other hand, an advantage that Steelhead Trout have over King Salmon in streams that become unsuitable during the summer months is that the upstream spawning migration of the adult fish takes place considerably later. In other words, it is not necessary for a good attracting flow in the stream to be present until December or even January, whereas water coming at such time of year is too late to attract King Salmon. Despite this advantage, it must be remembered that the young trout will hatch much later in the year than the King Salmon and that sufficient water must be present, not only for the successful hatching of the fish but also for their maintenance throughout the entire summer. Again, this is not the case with Cache and Putah creeks.

The construction of a fishway over the Capay Dam would provide passage for spawning salmon and steelhead in those occasional years that the fish reach the dam in

considerable numbers. Although the survival of the young is questionable, because of low water and high temperature conditions during the summer months, the depletion of the Sacramento River King Salmon has become so acute that a fishway over this dam would, in the opinion of the writer, be justified.

Although the Clear Lake Impoundment Dam is normally a barrier to salmon and steelhead, the construction of a fishway over it should be deferred until such time as a fishway was built over the Capay Dam and had proved successful, and it had been noted that salmon or steelhead in any considerable quantity reached the Clear Lake Impoundment Dam. Even if a fishway were built over the Capay Dam and was used by spawning salmon and steelhead, it might prove that these fish would turn up the North Fork of Cache Creek, which offers suitable spawning grounds and a supply of good clear water during the spring and early summer months (but becomes very low or goes dry through most of its course in the late summer and early fall).

Aside from the dams, there are no other barriers in Cache Creek. The belief of some persons that rock slides caused by old railroad construction provide an obstacle to fish at times of low or medium water is erroneous. No slides are present and the old railroad that ran to Rumsey does not approach the stream closely enough to cause slides.

Insofar as the tributary streams of Cache and Putah creeks that possess trout populations are concerned, neither their size nor the amount of fish and fishing in them justifies any radical change in the management policies of the Division of Fish and Game in regard to them. As time and funds permit, they should be examined more closely and individual stream improvement and stocking be carried out as needed.

The Small-mouthed Black Bass provides such fine fishing in Putah Creek that it is recommended that this stream be managed as a Small-mouthed Black Bass stream (Figs. 17 and 18). The present work of stocking and fish rescue should be continued and further adapted to meet the requirements of the stream. As time and funds permit, a study should be made of the desirability and possibilities of Carp and other scrap fish control.

Also as time and funds permit, a further study should be made of the reasons for the absence of Small-mouthed Black Bass in Cache Creek (Fig. 19).

Improvement of conditions as regards temperatures and stream flows can be effected only through the extensive cooperation of agricultural and grazing interests, sportsmen, and various State and Federal governmental agencies.

Since the migrations of the salmon in the Sacramento River have been touched upon, it might be desirable at this time to bring up a subject indirectly connected with Cache and Putah creeks, the Fremont Weir, which has been described previously. At this long concrete wall and apron across the Yolo By-Pass at its head conditions are far from satisfactory. There is some question regarding the extent of the migrations of various fishes through the Yolo By-Pass at such times as water is flowing through it. Some persons believe that at such times the main runs of King Salmon passing up the Sacramento River enter the By-Pass and proceed up it. The writer is inclined to believe that at least considerable numbers of salmon travel up it. In any case, the fact remains that after the water in the By-Pass recedes various kinds of fishes are often stranded in large numbers at the Fremont Weir, necessitating fish rescue work on the apron and in pot holes formed in the bed of the By-Pass below the weir.

Fig. 20 is a photo of Fremont Weir taken on June 21, 1940. When rescue work was done in 1940 considerable numbers of fish were taken at this point. After the first storm of the season only salmon were taken. After the second storm salmon, Striped Bass, Shad, and catfish were recovered.

On June 21 skeletons of several hundred Shad were seen on the apron near this point. Also, at times numbers of fish are taken illegally at the weir. Abe Woodard says that some 400 tons of salmon were bootlegged out of here about fifteen years ago.

The writer agrees with the view held by some persons that one or two passages for fish should be provided over the weir. These passageways should be probably 20 feet wide and could be in the form of fishways consisting of only several jumps of possibly even only breaks in the top of the wall. The top of the wall is about 8 inches lower at the point shown in the photograph than elsewhere. The concrete apron below is also wider here than toward the gage (it is about 40 feet wide at this point). Salmon, Shad, and Striped Bass congregate at the low place in large numbers at times and this seems to be the logical place at which to provide a passageway. As a result of the wall being lower here than at other points, a channel is already beginning to form in the By*Pass below this low spot. Large pot holes in which fish become stranded are also more numerous below this spot than opposite other parts of the Fremont Weir.

Effect of Central Valley Project Construction

It must be noted that changes created by the construction of the Shasta Dam and other features of the Central Valley Project may affect the situation as regards

Cache and Putah creeks. Control and leveling out of the fluctuations in flow at the Shasta Dam may alter the amount of water let down the Yolo By-Pass and the length of time over which it is let down. But even though water conditions are not affected insofar as Cache and Putah creeks are concerned, a change in the number of salmon in the Sacramento River due to the various constructions of the Central Valley Project will affect the number that will enter or attempt to enter Cache and Putah creeks.

Another point to be considered is that several dams have been proposed for the Cache and Putah creek systems, as well as other flood control measures, such as channel straightening and deepening. My understanding is that the U.S. Army Engineers have been engaged in such surveys during the present year. If any such dams are built or flood control measures undertaken, they may radically affect Cache and Putah creeks and the fishes in them.

Summary.

1. The present report is based on surveys made by the writer during the spring and summer of 1940.
2. U.S. Bureau of Fisheries workers who had made a study of the Shasta Dam salmon salvage problem in their report dismissed Cache and Putah creeks from consideration as streams for possible use in salvage of the salmon runs

now going past the site of the Shasta Dam on the basis of their distance from that point and their lack of suitable water.

3. Cache and Putah creeks nominally are tributaries of the Sacramento River on the west side, but in recent years no water from these streams has reached the Sacramento River through the original channels.
4. In the summer months the lower courses of Cache and Putah creeks are dry or intermittent.
5. In the winter months the water from these streams flows into the Yolo By-Pass and thence down the By-Pass to the latter's entrance into the Sacramento River, far below the original entrances of Cache and Putah creeks into the Sacramento River.
6. The belief of some persons that the water of Cache and Putah creeks could be passed into the Sacramento River directly by the construction of dikes 5 or 6 feet high is erroneous.
7. There is no feasible way of bringing the water of Cache and Putah creeks directly into the Sacramento River.
8. Since the Yolo By-Pass is used only to let down the excess water of the Sacramento River at flood stage, salmon and steelhead can only enter Cache and Putah creeks at such times. The runs of these fishes into these streams must necessarily occur only in years of favorable rainfall.
9. The construction of large dikes and channels to guide the

flood waters in the lower courses of Cache and Putah creeks would facilitate the entry of spawning salmon and steelhead at such times. Because of the previously cited conditions, these runs would even then take place only on occasional years. Even under such conditions the survival and exit of the young salmon and steelhead would be quite uncertain. Because of the uncertainty of positive results and because of the magnitude of the project, which would not only cost a very large sum but would also effect extensive agricultural and grazing interests, it is felt that such a project would be entirely outside the scope of work and province of the Division of Fish and Game.

10. The only two dams on Putah Creek are removed in the winter and are then not an obstacle to spawning fish.
11. The lowermost of the three dams on Cache Creek is also removable in the winter and is then no obstacle to fish. The middle dam, known as the Capay Dam, has no fishway and bars salmon and steelhead from ascending the stream. The construction of a fishway over this dam would provide passage to spawning grounds in those occasional years that the fish reach this dam. Although the survival of the young is questionable, the depletion of the Sacramento River King Salmon has become so acute that a fishway over this dam would, in the opinion of the writer, be justified.

12. The uppermost dam on Cache Creek, known as the Clear Lake Impoundment Dam, also has no fishway and normally is a barrier to fish. The construction of a fishway over it should be deferred until such time as a fishway has been built over the Capay Dam and has proved successful, and it has been noted that salmon or steelhead in any considerable quantity reach the Clear Lake Impoundment Dam.
13. The belief of some persons that in Cache Creek rock slides caused by old construction of a bed for a railroad provide an obstacle to runs of fish is erroneous. No slides are present and the old railroad that ran to Rumsey does not approach the stream closely enough to cause slides.
14. Because of prevailing high summer temperatures or the lack of water, practically the entire courses of Cache and Putah creeks and the lower portions of most of their tributaries are unsuitable for the maintenance of year-round populations of trout.
15. Some trout are to be found in the headwater tributary streams of the Cache and Putah creek systems. These form largely independent self-sustaining populations. Neither the size of the streams, nor the amount of fish and fishing in them, justifies a radical change in the management policies of the Division of Fish and Game in regard to them. As time

and funds permit they should be examined more closely and individual stream improvement and stocking be carried out as needed.

16. The Small-mouthed Black Bass are widely distributed in Putah Creek and spawn extensively practically throughout almost its entire course. This species provides such fine fishing that it is recommended that Putah Creek be managed as a Small-mouthed Black Bass stream. The present work of stocking and fish rescue should be continued and further adapted to meet the requirements of the stream. As time and funds permit, a study should be made of the possibilities and desirability of Carp and other scrap fish control.
17. No young Small-mouthed Black Bass were found in the Cache Creek system and no adults were seen, although some of the latter are probably present. As time and funds permit, a further study should be made of the reasons for the absence of these fish. It might be pointed out that whereas the water of Putah Creek is quite clear in the spring and summer, the water of Cache Creek is quite murky. The murkiness of the latter stream is due to the fact that the water is let out of Clear Lake and probably also to the fact that the water at the Clear Lake impoundment Dam is let out through outlet gates at the bottom, stirring up the bottom materials. The lack of natural propagation of the Small-mouthed Black Bass in this stream is probably associated with this factor.
18. Extensive water use, flood control measures, and erosion and

consequent silting up of the streams and filling in of the holes caused by overgrazing, deforestation, and road construction have increased the temperatures and lowered the summer flows of many of the streams. Improvement along these lines can be effected only through the extensive cooperation of agricultural and grazing interests, sportsmen, and various State and Federal governmental agencies.

REFERENCES

California Division of Water Resources

1931. Sacramento River Basin. Bull. No. 26, 583 pp.,
pls. I-LVI, 1931.

Coleman, George A.

1930. A biological survey of Clear Lake, Lake County,
Calif. Fish and Game, Vol. 16, No. 3, July, 1930,
pp. 221-227, fig. 69.

Hanson, Harry A., Smith, Osgood R., and Needham, Paul R.

1940. An investigation of fish-salvage problems in
relation to Shasta Dam. U.S. Bureau of Fisheries,
Special Scientific Rept. No. 10, 200 pp., maps.
Washington, D.C., 1940. (Mimeographed)

McGlashan, H.D.

1929. Surface water supply of the Sacramento River Basin,
California, 1895-1927. U.S. Geological Survey,
Water-Supply Paper 597aE, pp. I-VI, 189-250, 1929.

Shapovalov, Leo

1940. Report on proposed rehabilitation of salmon and
steelhead runs in Cache and Putah creeks. Report
submitted to the Calif. Division of Fish and Game,
March 11, 1940. 10 typewritten pp. and 5 photos.

MAPS

Calif. Division of Forestry.

1937. Administrative map of Lake County.

Calif. Division of Highways and U.S. Bureau of Public Roads

General Highway Maps of Lake, Napa, and Yolo counties.

7 sheets.

Corps of Engineers, U.S. Army

Lakeport, Bartlett Springs, Venada, Kelseyville, Lower Lake, Reiff, Rumsey, Calistoga, Pope Valley, and Capay tactical quadrangles.

U.S. Forest Service.

1935. Mendocino National Forest. 1/2 inch scale. Contour interval 200 feet.

U.S. Geological Survey.

1938. Lakeport Quadrangle. Scale 1:62500. Contour interval 50 feet.

1938. Plan and profile of Putah Creek, from a point 2 miles above Winters to Middletown, with dam sites. 6 sheets. Scale 1:31680.

1939. Plan and profile of Cache Creek, from a point 3 miles above Esparto to Mile 29, with dam sites. 3 sheets. Scale 1:31680.